CALIFORNIA
AGRICULTURAL EXTENSION SERVICE

CIRCULAR 85
April, 1934

GROWING AND HANDLING MARKET PEAS IN CALIFORNIA

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Coöperative Extension work on Agriculture and Home Economics, College of Agriculture, University of California, and United States Department of Agriculture coöperating.
Distributed in furtherance of the Acts of Congress of May 8, and June 30, 1914.
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Within recent years the growing and consumption of market peas within the United States has increased considerably. This has been brought about principally by increased shipments from the western states, especially California, which put peas on the markets at a time of the year when the districts of the East and North are not producing. Figure 1 shows the carlot shipments of peas in the United States and in California since 1925. Much of the crop produced near the large consuming centers is now being hauled to market by truck and therefore does not appear in these carlot totals.

PRODUCTION AREAS IN THE UNITED STATES

Production areas of more or less importance are scattered throughout the entire country. In 1927 California took the lead in carlot shipments and has maintained the lead since that time. Other important shipping states are New York, Colorado, North Carolina, South Carolina, Idaho, Virginia, Washington, and Mississippi. During the winter, large quantities of peas are imported from Mexico. The shipments of peas for different states for the years 1926–1932 are given in table 1. These data show that the chief increase in pea shipments since 1926 has been from California, Washington, Idaho, and Colorado. The acreage of market peas for the years 1928–1932 for the more important states is given in table 2. The approximate time when peas can be expected to move from the various states is given in table 3.

PRODUCTION AREAS IN CALIFORNIA

There are a number of pea-producing areas in California, the most important of which are in Imperial, Alameda, Monterey, Santa Clara, and San Luis Obispo counties. A number of other districts along the coast and in the interior valleys have come into prominence during the last few years, and there will probably continue to be some shifting until the most suitable locations for production have been determined. The carlot shipments by counties for the years 1926–1932 are given in table 4.

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SHIPPING SEASONS FOR CALIFORNIA PEAS

Market peas move from California in quantity from March to June and from September to December. The shipping seasons for the different counties vary some from year to year, depending upon climatic conditions. Table 5 indicates the approximate time when peas can be expected to move from the different districts.

TABLE 1

CARLOT SHIPMENTS OF PEAS BY STATES FOR THE YEARS 1926–1932*

State	1926	1927	1928	1929	1930	1931	1932†
Alabama	0	1	1	0	2	26	5
Arizona	19	32	3	10	26	25	83
California	803	1,361	1,642	2,205	3,494	3,016	4,882
Colorado	58	149	348	459	463	559	591
Florida	2	16	6	30	7	152	140
Georgia	2	0	0	0	0	0	0
Idaho	40	101	176	238	407	415	349
Kentucky	4	0	0	0	0	0	0
Illinois	0	0	0	1	0	0	0
Indiana	0	4	0	0	0	0	0
Iowa	0	0	0	1	0	0	0
Louisiana	0	0	1	1	2	7	0
Maine	0	1	0	0	0	0	0
Maryland	55	54	68	52	2	13	0
Michigan	0	0	1	0	0	0	0
Mississippi	233	243	250	199	234	282	46
Missouri	0	0	1	0	0	0	0
Montana	0	0	0	4	0	0	0
New Jersey	27	40	38	28	1	13	1
New Mexico	59	16	0	1	0	1	0
New York	1,110	975	837	731	892	431	351
North Carolina	596	570	685	368	482	554	284
Oregon	0	13	13	39	73	41	42
South Carolina	167	207	247	244	265	256	71
Tennessee	30	9	15	5	8	3	2
Texas	1	4	17	0	2	9	16
Utah	13	20	10	14	14	8	70
Virginia	288	259	281	222	129	232	75
Washington	64	111	152	334	791	539	829
West Virginia	0	0	0	1	0	0	0
Total for United States	3,571	4,186	4,792	5,187	7,295	6,582	7,837

* Data from: U. S. Dept. Agr. Crops and Markets, monthly issues.

† Subject to revision.

The growing of fall peas has developed into a considerable industry in Santa Clara, Monterey, and Imperial counties. Most of the crop from Santa Clara and Monterey counties moves during September and October; that from Imperial is somewhat later, moving in late October, November, and early December. Most of the spring shipments are from

Imperial, Monterey, Alameda, San Luis Obispo, Santa Clara, and Santa Barbara counties. The spring crop from Imperial County usually begins to move in January, reaches a peak in March, and finishes early in

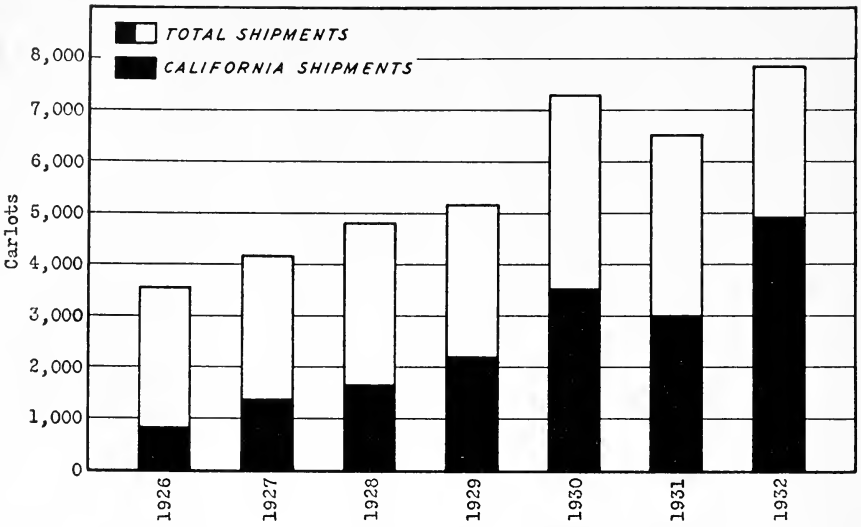

Fig. 1.—Carlot shipments of peas for the United States for the years 1926–1932. Shaded portions are California shipments.

TABLE 2

ACREAGE OF MARKET PEAS BY STATES, 1928–1932*

State	1928	1929	1930	1931	1932
Alabama	.....	.....	.....	250	420
Arizona	500	300	170	520	150
California	25,810	31,530	41,800	43,700	66,900
Colorado	4,900	7,100	5,820	6,500	11,050
Florida	1,230	1,350	700	2,000	3,800
Idaho	1,000	1,150	2,500	3,000	2,700
Louisiana	1,330	1,430	1,420	1,200	1,200
Maryland	800	820	820	650	600
Mississippi	2,200	2,310	2,400	2,350	1,800
New Jersey	3,800	3,600	3,600	3,000	3,000
New York	4,880	5,210	5,920	6,150	7,000
Oregon	160	400	600	620	540
Tennessee	500	150	150	120	100
Texas	.....	.....	340	960	200
Virginia	3,000	2,600	3,220	1,600	1,490
Washington	.....	1,700	2,900	3,000	3,240
Total for United States	57,600	65,550	80,200	82,270	111,090

* Data from: U. S. Dept. Agr. Crops and Markets. p. 477. December, 1932.

April. The chief competing areas in March are Imperial and San Luis Obispo counties. In July most of the carlot shipments are from the Salinas Valley and from the Fort Bragg district in Mendocino County.

TABLE 3

CARLOT MOVEMENTS AND SEASONS OF SHIPMENT OF GREEN PEAS BY MONTHS FOR THE VARIOUS STATES, 1932*

State	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
California:													
Northern	0	0	0	4	149	52	52	1	2	9	2	0	271
Southern	0	0	34	24	0	4	0	0	0	0	0	0	62
Central	0	0	215	1,093	702	338	27	16	607	325	59	15	3,397
Imperial Valley	1	8	445	42	0	0	0	0	0	0	412	244	1,152
Total for California	*1*	*8*	*694*	*1,163*	*851*	*394*	*79*	*17*	*609*	*334*	*473*	*259*	*4,882*
Alabama	0	0	4	0	0	1	0	0	0	0	0	0	5
Arizona	0	0	0	16	0	0	0	0	0	52	15	0	83
Colorado	0	0	0	0	0	10	69	494	18	0	0	0	591
Florida	58	56	6	2	0	1	0	0	0	0	1	16	140
Idaho	0	0	0	0	0	110	43	136	60	0	0	0	349
Mississippi	0	0	11	21	14	0	0	0	0	0	0	0	46
New Jersey	0	0	0	0	0	1	0	0	0	0	0	0	1
New York	0	0	0	0	0	71	214	65	0	1	0	0	351
North Carolina	0	0	0	0	273	11	0	0	0	0	0	0	284
Oregon	0	0	0	0	2	30	0	2	7	1	0	0	42
South Carolina	0	0	1	45	24	0	0	0	0	0	1	0	71
Tennessee	0	0	0	0	2	0	0	0	0	0	0	0	2
Texas	13	2	0	0	0	0	0	0	0	0	0	1	16
Utah	0	0	0	0	0	26	23	14	7	0	0	0	70
Virginia	0	0	0	0	54	9	0	0	0	1	11	0	75
Washington	0	0	0	0	0	67	571	185	6	0	0	0	829
Total for the United States	72	66	716	1,247	1,220	731	999	913	707	389	501	276	7,837

* Subject to revision. Data from: U. S. Dept. Agr. Crops and Markets, monthly issues.

TEMPERATURE REQUIREMENTS

The highest yields of marketable peas are obtained when the crop is raised under fairly cool climatic conditions. If grown during hot weather, certain diseases, especially mildew, are more prevalent; the vines are stunted; and the yield is lowered. When the seed is planted in

TABLE 4

CARLOT SHIPMENTS OF PEAS BY COUNTIES FOR CALIFORNIA, 1926–1932*

County	1926	1927	1928	1929	1930	1931	1932
Alameda	254	304	381	378	597	624	869
Contra Costa	0	13	2	6	16	23	64
Fresno	1	0	0	0	0	0	1
Imperial	364	602	778	766	1,488	679	1,153
Kern	0	0	0	0	0	7	20
Los Angeles	0	3	9	1	4	2	43
Mendocino	0	0	0	0	0	28	100
Merced	0	0	0	0	0	0	18
Monterey	105	176	240	296	524	602	822
Napa	0	0	0	0	0	8	0
Riverside	13	0	0	0	0	4	19
Placer	0	0	0	0	0	13	1
Sacramento	0	0	7	5	3	8	106
San Benito	0	2	2	0	0	0	5
San Diego	0	0	0	37	8	0	0
San Francisco	7	18	0	0	0	0	0
San Joaquin	2	0	40	23	36	30	110
San Mateo	6	1	1	27	7	0	125
San Luis Obispo	3	91	67	345	141	184	364
Santa Barbara	39	94	45	44	116	54	118
Santa Clara	15	28	63	183	420	632	736
Santa Cruz	0	0	0	56	30	112	53
Solano	0	0	0	0	2	0	0
Sonoma	0	0	0	0	0	0	4
Sutter	9	0	0	0	0	0	3
Tulare	0	0	0	0	1	3	15
Ventura	0	14	5	38	1	3	0
Yolo	0	2	0	0	0	0	0
Yuba	3	0	0	0	0	0	38
Total	832	1,348	1,642	2,205	3,394	3,016	4,891

* Data from: U. S. Dept. Agr. Bur. Agr. Econ. Fruit and Vegetable Div. Summary of carlot shipments of important fruit and vegetables in California, Arizona, and Nevada, 1932. Federal-State Market News Service. Los Angeles. May, 1933.

wet soil during hot weather it often rots in the ground causing poor stands. This often happens to the crop that is planted during the summer for fall production. Also extremely hot weather often burns young plants that are but a few inches high.

The young plants tolerate considerable cold, but the flowers and green pods are often injured by frosts (fig. 2) that do not damage other

TABLE 5

CARLOT SHIPMENTS OF PEAS BY MONTHS FOR CALIFORNIA COUNTIES, 1932*

County	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Alameda	0	0	9	501	306	120	4	0	17	5	6	1
Contra Costa	0	0	0	23	14	0	0	0	8	18	1	0
Fresno	0	0	0	0	0	0	0	0	0	0	1	0
Imperial	1	8	445	42	0	0	0	0	0	0	412	245
Kern	0	0	0	0	0	0	0	0	0	0	13	7
Los Angeles	0	0	17	22	0	4	0	0	0	0	0	0
Mendocino	0	0	0	0	0	47	52	1	0	0	0	0
Merced	0	0	0	11	5	0	0	0	0	0	1	1
Monterey	0	0	0	163	306	43	20	0	112	153	25	0
Placer	0	0	0	1	0	0	0	0	0	0	0	0
Riverside	0	0	17	2	0	0	0	0	0	0	0	0
Sacramento	0	0	0	3	97	5	0	0	1	0	0	0
San Benito	0	0	0	5	0	0	0	0	0	0	0	0
San Joaquin	0	0	0	90	1	0	0	0	0	0	0	0
San Luis Obispo	0	0	193	129	0	0	0	9	33	0	0	0
San Mateo	0	0	0	0	23	101	1	0	0	0	0	0
Santa Barbara	0	0	9	48	17	30	0	2	12	0	0	0
Santa Clara	0	0	4	110	16	16	0	5	431	149	5	0
Santa Cruz	0	0	0	9	14	28	2	0	0	0	0	0
Sonoma	0	0	0	0	0	0	0	0	0	4	0	0
Sutter	0	0	0	0	0	0	0	0	0	1	2	0
Tulare	0	0	0	0	0	0	0	0	0	0	7	8
Yuba	0	0	0	0	38	0	0	0	0	0	0	0

* Data from: U. S. Dept. Agr. Bur. Agr. Econ. Fruit and Vegetable Div. Summary of carlot shipments of important fruit and vegetables in California, Arizona, and Nevada, 1932. Federal-State Market News Service. Los Angeles. May, 1933.

parts of the plant. Sometimes, before the plants are in bloom, a severe frost kills them to the ground, but later they stool out and produce a heavy crop. Spring frosts often ruin the crop intended for spring shipment. A hard frost in the fall terminates the shipping season.

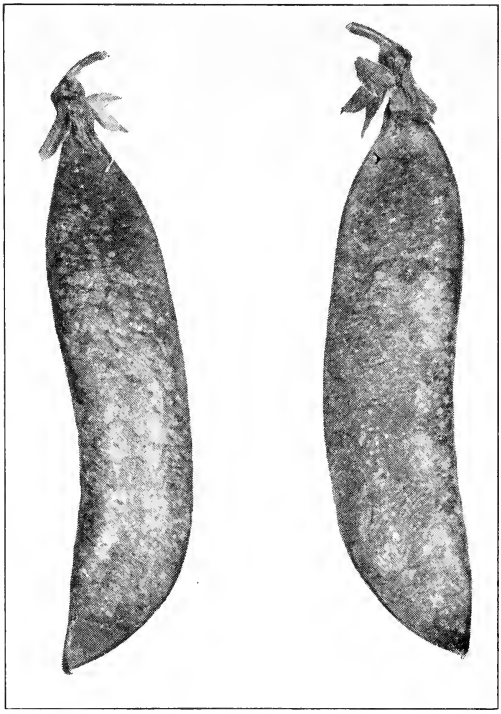

Fig. 2.—Frost injury of pea pods.

SOIL REQUIREMENTS

Peas will grow on a variety of soil types; but it is essential that the land be well drained. Clay and silt loams usually produce higher yields than the lighter soils because they are cool, retentive of moisture, and usually more fertile.

MAINTAINING SOIL FERTILITY

Crop Rotation.—In the Imperial Valley better results are usually secured when peas follow a cultivated truck crop such as cantaloupes, rather than cotton or grain sorghums, although good results are secured when peas follow either of these crops on rich, fertile soil. Also after breaking up alfalfa or Bermuda-grass sod, the growers prefer to raise one or two crops of cantaloupes, lettuce, or other cultivated crops before planting peas.

Peas have been grown in the Pismo section of San Luis Obispo County for 20 years and without any crop rotation. In the Nipomo district, where peas have been grown commercially for the last 8 or 9 years, rotation with beans and barley is practiced; usually peas are grown for 3 years, then barley, and beans for 1 year each, followed by peas again. The price of beans and barley influence to a considerable extent the part that they play in the rotation.

Most of the soils would be benefited by turning under the vines after the crop is harvested; but where the crop depends entirely upon winter rainfall there is usually not enough moisture in the soil after harvest to rot the vines when plowed under. A few growers, however, do disk and then plow the vines into the soil after harvest; the more general practice is to cut and haul them off for cattle feed.

Manures and Commercial Fertilizers.—The use of manures or commercial fertilizers is seldom profitable in Imperial Valley, unless the land is very sandy or the crop has been grown in succession on the same soil for several years. In some instances, particularly on light or rather infertile soils, the addition of 200 to 300 pounds of superphosphate per acre has given increased yields. Nitrogen and potash fertilizers have not proved profitable.

In San Luis Obispo County only the Pismo area has used commercial fertilizers to any extent. The Japanese who have been growing peas on the same land for 12 to 15 years have resorted to the use of fertilizers. Chicken manure has given the best results. Neither the Arroyo Grande nor Nipomo districts have included fertilizers in their program as yet.

Fertilizer trials in San Luis Obispo County in 1933 failed to show any appreciable benefits when the following combinations were used: superphosphate alone; superphosphate and potash; superphosphate, potash, and nitrate; guano alone; and sulfate of ammonia alone. These trials were carried on in the heavy soils of Nipomo, the sandy soils of Arroyo Grande, the shale soils of Pismo, and the heavy loam soils of Morro Creek.

In the Salinas Valley peas respond readily when manures and other organic fertilizers are added. When these are not available, sulfate of ammonia or nitrate of soda should be applied at the rate of 200 to 400 pounds per acre. The best time to apply is shortly before the plants begin blooming, and just before an irrigation unless there is sufficient rain to carry the fertilizer into the soil. Many growers plant peas to be used primarily as a green-manure crop. If the market is satisfactory at harvest time the peas are picked; if not the vines are plowed under.

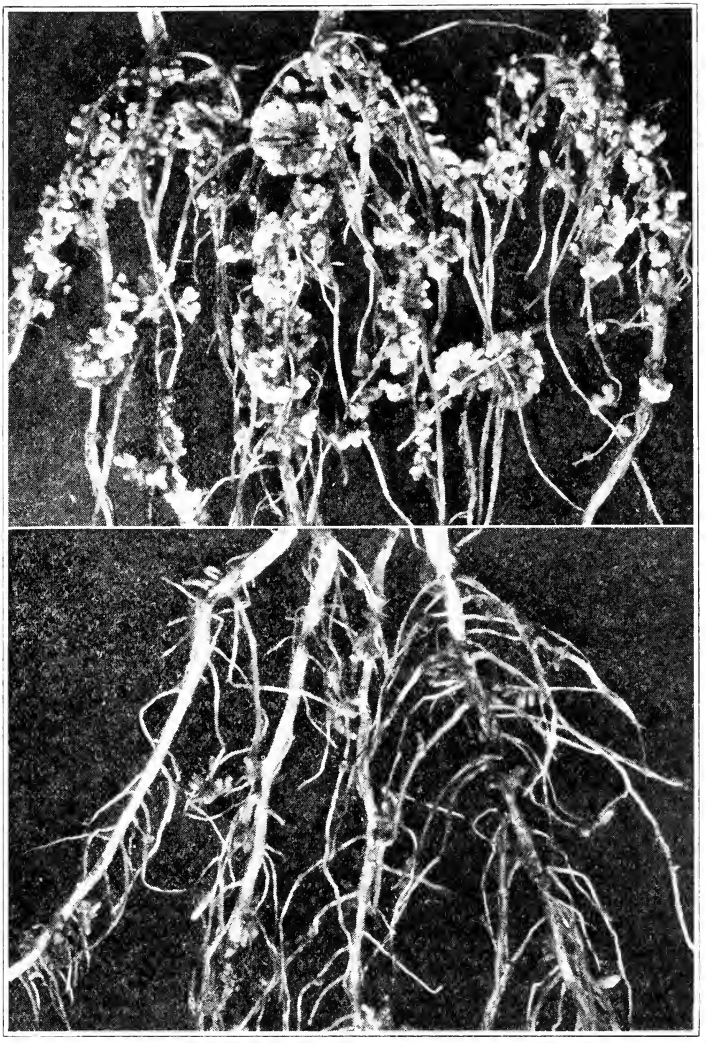

Fig. 3.—Upper: The seed that produced these roots was inoculated with pure-culture bacteria at the time of planting. Although there were many more nodules as a result of inoculation, there was no increase in yield of fresh peas. Lower: Check plants. The variety used was Hundredfold and the plants were grown by the Division of Truck Crops, Davis, California.

INOCULATION

The roots support the growth of nitrogen-fixing bacteria which form upon them abnormal growths called nodules or tubercles (fig. 3). If these tubercles are not formed it indicates that the specific bacteria necessary for the inoculation of this crop are absent from the soil and the seed should be treated. Inoculation is usually secured by direct ap-

plication to the seed of the proper strain of bacteria in pure culture. Inoculation is performed only when the soil does not contain the necessary organism; in California, most of the soils seem to be well supplied. Certain strains of nodule bacteria invade the roots of one kind of legume only, while other strains may invade a number of different species. The garden pea bacillus will also inoculate Canada field peas, common vetch, hairy vetch, narrow-leaf vetch, purple vetch, broad bean, lentil, and sweet pea.

TABLE 6

TOP AND ROOT GROWTH OF THE VARIETY DWARF TELEPHONE AT DAVIS, 1926–1927

Date plants were dug	Root growth in inches		Length of top, inches
	Diameter spread	Depth penetration	
January 15	.....	4.0	3.2
January 25	4.5	4.5	3.2
February 1	4.7	5.0	3.5
February 8	4.7	6.0	3.5
February 15	5.2	6.0	3.5
February 22	7.5	8.0	3.5
March 1	7.5	8.0	4.0
March 8	7.5	8.5	5.0
March 15	7.5	8.0	6.5
March 22	8.0	10.0	8.5
March 27	10.0	11.0	11.0
April 5	28.0	39.0	13.0
April 12	42.0	41.0	15.0
April 19	40.0	50.0	21.0
April 26	.....	64.0	24.0

* Data from the Division of Truck Crops.

ROOT DEVELOPMENT

During the winter and spring of 1926–27 a study was made at Davis, of the downward and lateral root growth of the Dwarf Telephone variety. The upper 18 inches of soil was a silt loam, below this it was a fine sand. The seed was planted on December 8, 1926. The first records were taken on January 15. The roots grew very slowly throughout the winter, but after late March growth was very rapid and they finally penetrated to a depth of 64 inches. On January 25 there were nodules on the taproot and on February 1 they were developing on the laterals. On April 26 the plants were in full bloom. From January 15 to March 27 the data represent the average of 10 plants; from April 5 to 26 one plant only was removed on each date.

PREPARATION OF LAND FOR PLANTING

The general practice in San Luis Obispo County and along the coast where the crop is not irrigated is to plow and harrow the land after the crop is off and have it lay fallow during the summer. This gives thorough aeration, slacks the clods that are left after plowing, and leaves the

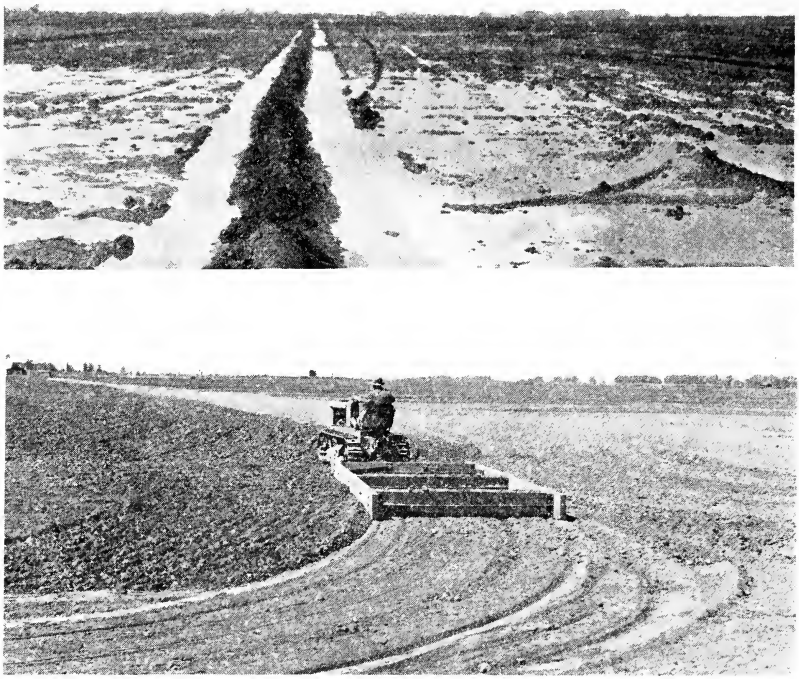

Fig. 4.—Preparation of land for peas. Upper: Flooding, after leveling and bordering the land. Lower: Smoothing and leveling just before bedding. (From Cir. 308.)

ground in excellent shape for early planting which is usually done just before the first rains are expected or just after they have occurred. The peas do best when planted shallow. The seed bed, therefore, should be in the very best possible condition. When seeding is done on dry soil, the usual practice is to smooth the land before planting by use of a roller or a clod masher.

For the fall crop in the Imperial Valley it is desirable to plow the land as deeply as possible and allow it to remain in this rough condition as long as possible to become thoroughly aerated. Before planting, the

Fig. 5.—Tractor pulling three-row lister to make pea beds. Most of the large operators make beds by pulling two or three listers behind a tractor. The beds can be made more quickly and economically and can also be made straighter and higher than when horses are used. (From Cir. 295.)

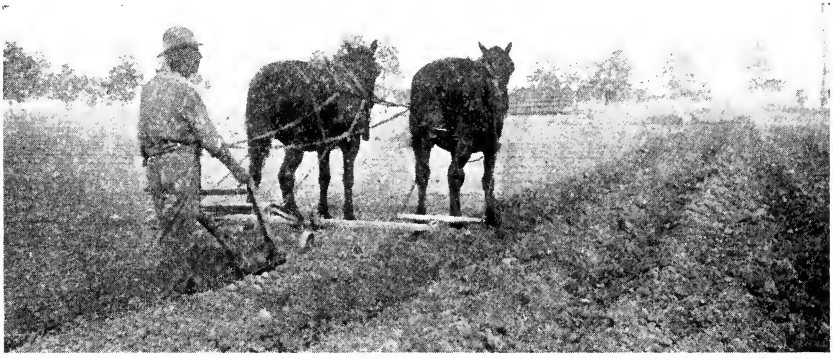

Fig. 6.—Making ridges with single and double listers. (From Cir. 295.)

land is double-disked or harrowed, bordered, and given a quick irrigation; the borders are then knocked down and the land disked and floated (fig. 4). When sod is broken or a crop of cotton or grain sorghum turned under, the land is usually double-disked and then replowed.

Planting peas on raised beds is the general practice in the Imperial Valley. The beds are made 8 to 12 inches high and 36 to 48 inches from center to center. From one to three 14 or 16-inch listers drawn by horses or tractors are used in making the beds (figs. 5 and 6). The field is then given a slow and very thorough irrigation. As soon as the soil is dry enough, the tops of the ridges are smoothed with a 2 or 3-section drag harrow with planks behind, three beds being smoothed in one operation. For the spring crop many growers prefer to have the beds run north and south so both rows of the bed will secure about equal amounts of sunlight, and develop uniformly. For the fall crop (planted in early September) the beds are generally run east and west; the north row of each bed is planted first and about 7 to 10 days later the south row is planted. This method of planting gives some protection against the high temperatures prevailing at that season of the year.

In the Salinas district most growers seem to prefer to plant on flat land rather than on beds. For irrigation, a furrow is made in each middle or every other middle. When irrigation is necessary, the growing of the crop on raised beds is preferable. These are made 4 to 6 inches high and 40 inches from center to center. Two rows, about 14 inches apart, are planted on each bed.

TIME OF PLANTING

The winter acreage along the coast in San Luis Obispo County is usually planted by November. If rains come early, the peas start growing and picking may begin as early as February. There is a tendency now to plant half the acreage in dry soil and the other half after the rains begin. There is, of course, always danger that the first rains will sprout the seed but not provide moisture enough to keep them growing. The danger of the loss from having to replant is more than offset by the advantage of getting in on the early market.

In the Imperial Valley peas are grown both as a fall and as a spring crop. For the fall crop, the seed is planted from about September 1 to October 1. If the weather is extremely hot, seed planted before September 10 often rots or the young plants are liable to be burned. For the spring crop, planting is usually done from October 15 to November 15.

In the Salinas Valley and in the Santa Clara Valley seeding for the early spring harvest is usually done late in November or the first part of December. Plantings made in January or even in early February ma-

ture satisfactorily for spring harvest. For fall harvest, plantings are made the latter part of June or the first of July. While it is possible to plant later than this, better results are obtained if the seed is germinated before the full heat of summer.

RATE OF SEEDING

The early fall crop in the Imperial Valley is grown on raised beds, two rows 12 to 14 inches apart being planted on top of each bed, and using 70 to 90 pounds of seed per acre. Many growers are now planting their

Fig. 7.—Planting the fall crop of peas in the Imperial Valley. Four rows are being planted in one operation.

fall peas in single-row beds, 36 inches apart, and using about 50 pounds of seed per acre. By using single rows harvesting is not so difficult, and the vines are damaged less in picking. When single rows are used for the spring crop, these are sown on beds 36 to 42 inches from center to center, 20 to 30 pounds of seed being used per acre.

Along the coast, from 50 to 100 pounds of seed is planted per acre—about 60 pounds being the amount most commonly used. The rows are spaced 22 to 30 inches apart, according to the variety. The dwarf-topped varieties are planted closer than the medium or tall types.

PLANTING METHODS

In most districts two-row corn or cotton planters, fitted with special plates, are used in planting the seed. In the Imperial Valley, skeleton-type wheel planters (fig. 7) are used with the heel and shoe narrowed to ½ inch to keep out dry clods and soil. These straddle the furrow when planting. Some growers use a small chain behind the planter to cover the seed, while others harrow the tops of the beds lightly after seeding.

IRRIGATION

On the steep hillsides along the coast, peas are planted in the late fall for early-spring harvest. It is not possible to irrigate these and the crop must be grown with the natural rainfall. Occasionally the winter rains alone are sufficient even where irrigation is possible. Where the winter rainfall is sufficient it is usually only necessary to pre-irrigate the crop that is planted during the summer. In the Imperial Valley, however, it is necessary to pre-irrigate for both the fall and spring crops. The land

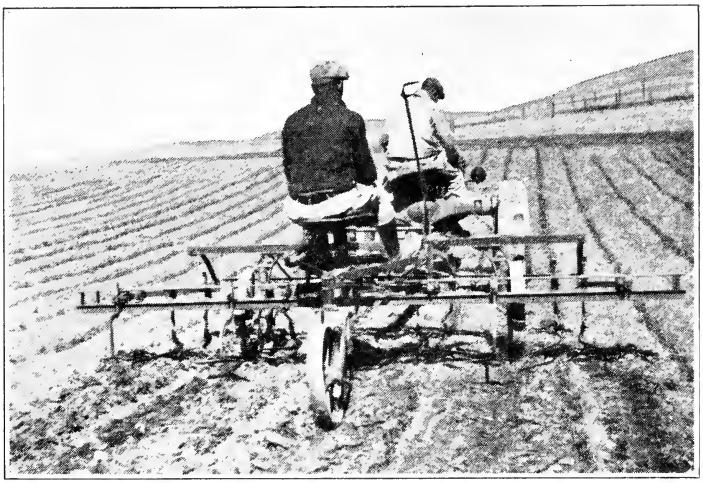

Fig. 8.—Cultivating four rows of peas at one time. It is necessary to keep weeds under control during the early growth of the plant.

is flood-irrigated, then bedded, and before planting a thorough irrigation is given to wet the soil to the tops of the beds and to a depth of 4 to 6 feet or more. In medium or heavy soils this is best accomplished by letting small streams of water trickle slowly down the furrows. In light soils it is necessary to use a large head of water. A light quick irrigation is usually given 5 to 7 days after planting when the seedlings are coming through the ground. At this irrigation it is important to prevent the water from wetting the tops of the beds and sprouting weed seeds, because the pea vines grow quickly and make it difficult to cultivate the tops of the beds. Some growers omit this second irrigation for the fall crop. The spring crop receives from four to eight irrigations while the fall crop receives from one to three. The general practice in the Imperial Valley is to irrigate after each picking. Most growers give a heavy irrigation just after blossoming begins.

In San Luis Obispo County the pole-pea crop, grown during the summer, is the only one that is irrigated.

CULTIVATION

Undoubtedly too much stress is placed on cultivation, the object of which should be to kill weeds and prepare the soil to receive the next irrigation. Where weed growth is not a serious consideration, and water penetrates readily, growers can lower costs considerably by reducing the number of cultivations.

The winter crop along the coast is usually worked as soon as the rows are well defined and can be followed. The practice is to cultivate after

Fig. 9.—Pea-harvesting scene in the Imperial Valley. Peas are picked into five-gallon cans and then dumped into burlap sacks which are hauled to the packing shed. (Courtesy, E. L. Garthwaite.)

every packing rain. On steep hillsides, a one-horse cultivator is the most convenient to handle; but where the acreage is large and the land level, a four-row implement is used (fig. 8). Usually three to four cultivations are given before picking begins.

HARVESTING

Harvesting is done entirely by hand. The pickers go through the field and remove the well-filled pods. As a rule, the field is gone over two or more times according to the variety, the season of the year, and other factors. Usually the vines of the very early varieties do not stand handling so well as the midseason or late varieties, and great care must be exercised in picking.

The peas, as picked, are placed in baskets, hampers, buckets, coal-oil cans, or other containers (fig. 9). When filled, these are usually taken to

temporary receiving stations in the field where the harvest is inspected and weighed (fig. 10). The pickers are paid by the hour or by the pound. After inspection and weighing, the peas are sacked or crated to be hauled to nearby markets or are first taken to the packing shed where they are prepared for shipment.

A considerable quantity of peas intended for Pacific Coast markets is sacked or packed in crates in the field and hauled direct to market by trucks.

Fig. 10.—The peas from each picker are being weighed, inspected, and placed in sacks to be transported to the packing shed. (Salinas Valley.)

Pea harvesting is a slow process so a large force of pickers is generally necessary. One hundred pickers working together in the same field is a common sight where peas are grown on a large scale. A good picker should harvest 300 pounds or more per day. One to four pickers are required to harvest an acre in a day. Some growers prefer a continuous harvesting season, while others prefer to have the entire field picked in one or two days and then stop until the field is ready for another picking several days later.

Field inspection is very important; at least one inspector should be provided for every 50 pickers. Only healthy, well-filled pods should be harvested. All immature, overmature, shriveled, or defective pods should be discarded in the field. The peas should be hauled to the loading shed, and placed into the refrigerator cars as soon after picking as possible.

YIELD

The yield per acre varies widely, according to the variety, the natural fertility of the soil, the skill of the grower, insect pests, diseases, and climatic conditions. On irrigated land, 6,000 pounds or more per acre is not an unusual yield for the dwarf types; the average, however, is from about 2,200 to 3,700 pounds. Under dry-farming conditions 750

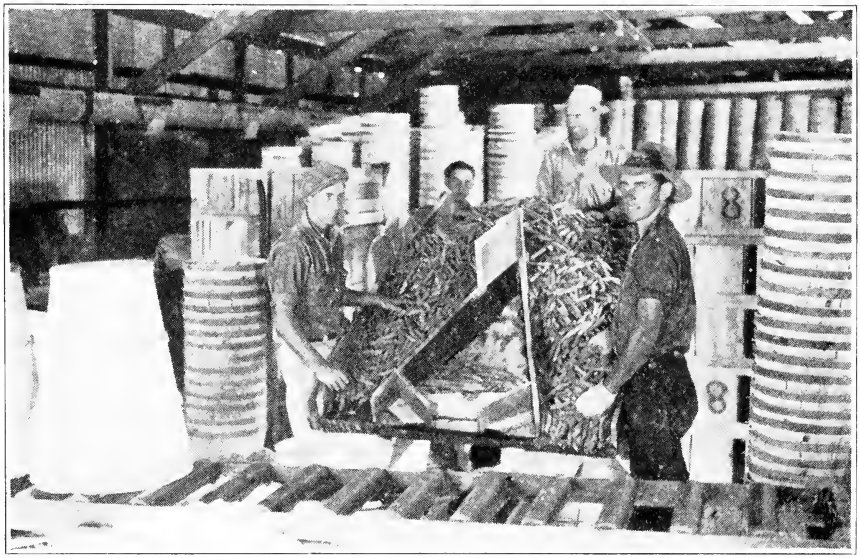

Fig. 11.—Grading and packing pole peas at Oceano.

to 1,050 pounds per acre is considered a fair yield. During the season of 1931, in Monterey County, production on 6,000 acres, both irrigated and dry farmed, averaged 1,980 pounds per acre actually shipped.

In the Imperial Valley, the yield of the fall crop ranges from about 1,000 to 4,000 pounds per acre, while that of the spring crop ranges from 2,000 to 6,000 pounds.

GRADING AND PACKING

The grading and packing of peas is usually done in a central warehouse. The peas as they come from the field are dumped into a hopper and passed on to a conveyor belt. The graders remove the undesirable pods as they are carried along on the belt. Another type of grader in common use is shown in figure 11. The marketable peas are dropped into a receiving box or hamper, holding approximately one bushel, and then emptied into the containers used for shipping.

Containers.—For shipping there are four types of containers in addition to sacks (fig. 12). They are the two-bushel crate which is not used extensively; the bushel box crate which comes in two different dimensions; and the bushel hamper. The tendency at present is to get back to shipping peas in the bushel hamper. Peas seem to carry better in the

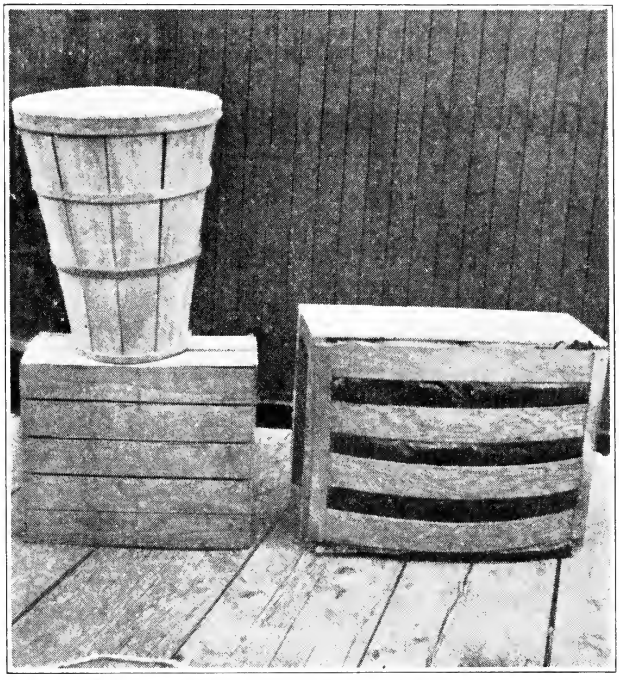

Fig. 12.—Types of containers that are used to ship peas from California. These are the one-bushel hamper, one-bushel box, and two-bushel crate.

hampers, probably because there is room to pack ice about the hamper. Boxes and crates set too close together do not allow good icing and proper ventilation.

If the peas are to be iced, approximately three pounds of crushed ice is placed in the center of the hamper or crate when it is half full.

CALIFORNIA STANDARDS FOR PEAS

All green market peas offered for sale in California must comply with the provisions as set forth in the Agricultural Code of California:

Pods of peas shall not be poorly filled or over-mature; and shall be free from insect larvae and from serious damage due to insects, freezing, mildew, decay, or other causes.

Damage to any one pod is not serious unless twenty per cent or more of the peas in the pod are affected.

Not more than ten per cent of the pods in any one container or bulk lot may be below these requirements, but not to exceed one-half of this tolerance shall be allowed for any one cause.

Pods of peas are not "poorly filled" if one-half or more of the pod is filled with fairly well developed peas.

"Overmature" means that more than one-third of the surface of the pod is wrinkled, shriveled, or yellow.

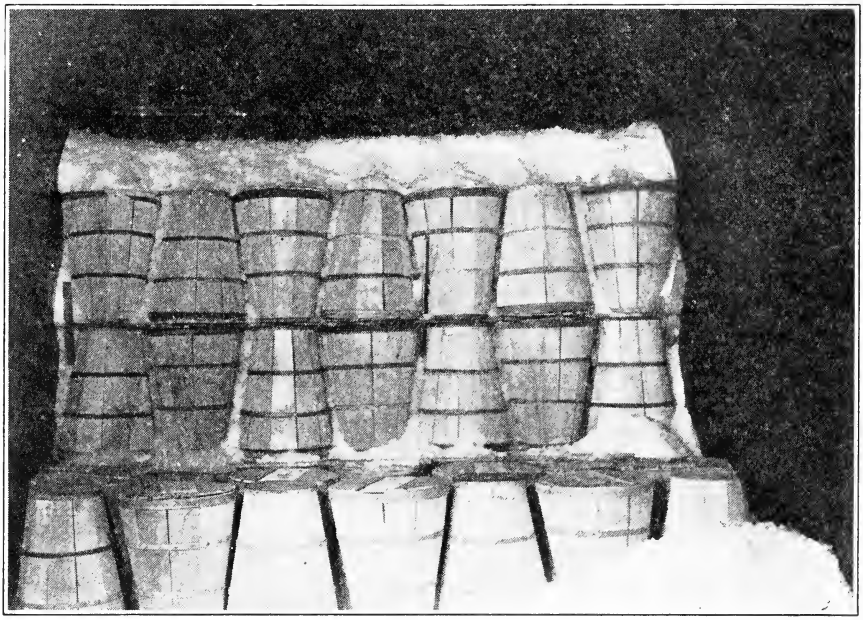

Fig. 13.—Packing hampers of peas in cars at Oceano.

LOADING AND ICING

The pack is loaded into refrigerator cars as lidded. Each tier of hampers or crates is held in place by board strips running crosswise of the car. From 10,000 to 15,000 pounds of crushed ice or chunks of ice is placed between and on top of the containers in the car. The general practice at present is to crush the ice rather than to place it on the load in blocks (fig. 13). This keeps the temperature in the car low and insures arrival in good condition. During warm weather ice is also placed in the bunkers at the time of loading.

VARIETIES

While there are many varieties of market peas, only a few of these are used in California. The early dwarf types, while producing well in the spring, are of little value for planting at other times of the year. Warm

weather accentuates the dwarfness to a point where growth is inadequate for profitable production.

In table 7 are given data regarding yield and relative time of maturity for the varieties that are planted most extensively at the present time for shipping purposes. Of these Laxton's Progress is the most important early variety, and Stratagem the most important late variety.

Laxton's Progress.—This is the earliest of the large-podded dwarf types and is especially adapted to winter and early spring planting. The vines grow to a length of 18 to 24 inches. The pods and vines are dark

TABLE 7

COMPARATIVE YIELDS AND RIPENING DATES FOR IMPORTANT SHIPPING VARIETIES OF PEAS

Variety	Trials at Davis (Seed sown January 9, 1933)*		Trials at Arroyo Grande (Seed sown December 31, 1932)		Trials at Salinas (Seed sown Feb. 20, 1932)†
	First commercial picking	Yield in pounds per acre	First commercial picking	Yield in pounds per acre	First commercia picking
Stratagem	May 16	15,754	May 12	6,972	June 4
Morse's 200	May 16	11,601	May 12	7,842	May 31
Dwarf Telephone	May 16	13,024	May 8	10,166	May 31
Lincoln	May 10	13,943	May 18	8,715	.....
Morse's Market	May 10	9,733	April 29	9,877	May 28
Laxtonian	May 3	7,171	April 29	7,553	May 18
Hundredfold	May 3	7,972	April 24	6,898	May 24
Laxton's Progress	May 2	6,921	April 19	7,854	May 16
Little Marvel	April 29	9,001	April 19	7,134	May 18

* Data from Division of Truck Crops.

† Data from Ferry-Morse Seed Company, Salinas.

green in color; the pods are smooth, 4 to 4½ inches long, and about ⅞ inch wide—pointed and slightly curved at the tip (fig. 14). Under favorable growing conditions, marketable pods are produced in about 60 days. The mature seeds are large, wrinkled, and cream colored.

Hundredfold.—This is a very popular shipping variety in some districts of California because of its hardiness and prolificacy. The vines are 24 to 32 inches long, dark green, wiry, and with rather small foliage. The pods vary from 3¾ to 4½ inches in length and are pointed, dark green, and single, but under most conditions not so smooth and attractive as those of Laxton's Progress and the pods mature a few days later.

Laxtonian.—The Laxtonian is similar to Hundredfold in type. The vines are dwarf and bushy, and light in color. In most strains the pods are dark green, fleshy, and attractive. They are not quite so large as those of Laxton's Progress.

Morse's 200.—This is a good variety for fall harvest and is also desirable for spring planting. The vines grow to about the same length as

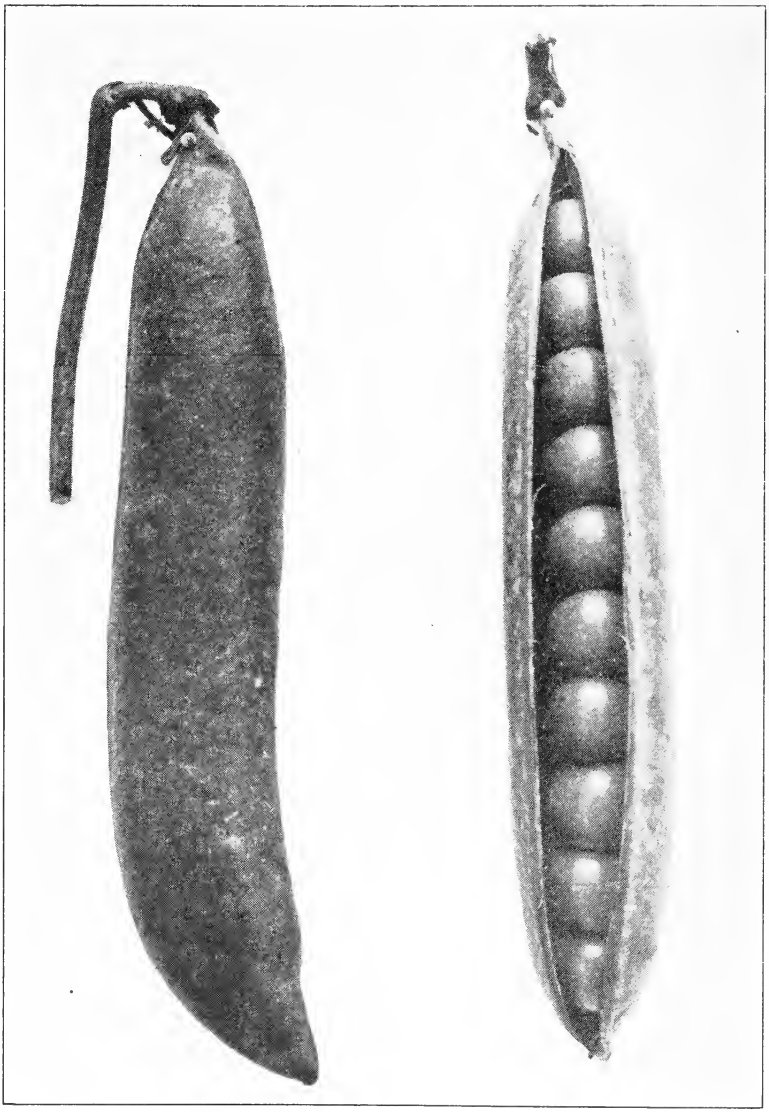

Fig. 14.—Laxton's Progress pods, actual size. This variety is the one planted most extensively along the coast for early spring harvest. (Courtesy, Ferry-Morse Seed Co.)

those of Stratagem. The pods are deep green in color, pointed, and a little broader than in the case of Stratagem. It matures at about the same time or a little earlier than Stratagem.

Roger's Icer.—There are a number of selections of this variety sold under different names. It is a dwarf type. The pods are of good color and about 5 inches long. There is a slight tendency towards puffiness in the pods and lack of filling under some conditions. It matures slightly earlier than Stratagem.

Associated 40, Dwarf Alderman, and Stridah.—Although these three varieties have a different history they are almost indistinguishable from

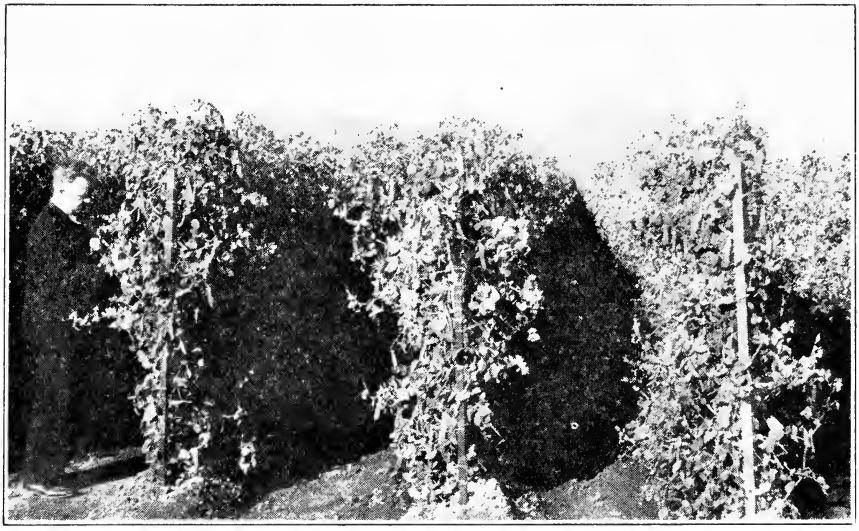

Fig. 15.—Pole peas in full production, Morro Bay. Variety, Alderman.

each other. They all have a tendency to become puffy and not fill well. The color of both foliage and pods is dark green. The pods are about 5 inches long. They mature at about the same time as Roger's Icer, and with it constitute the most important varieties for the Imperial Valley spring crop.

Stratagem.—This has been one of the most popular of the late dwarf varieties. It is especially well adapted for warm-weather conditions and is grown extensively as a spring crop in the interior valleys as well as a fall crop along the coast. The vines are 20 to 30 inches long, dark green, and coarse. The pods are about 4½ inches long, pointed, dark green, and occur singly and in pairs. This is a late-maturing variety.

Dwarf Telephone or Daisy.—This is one of the older varieties which has long been popular for market purposes. In recent years, however, it has lost much of its popularity because of the market preference for dark-green pods. The vines are about 20 inches long, light green, coarse, and luxuriant. The pods are about 4½ inches long, pointed, slightly

curved, and light green. The pods occur singly and in pairs. The crop matures at about the same time as Stratagem.

Alderman.—This variety is used extensively for pole purposes in the vicinity of Morro Bay and Arroyo Grande and to some extent in other districts along the coast. It produces well even when not poled and is used extensively for late spring, summer, and early fall harvest. The vines are medium dark green, rather coarse, and grow to a height of 5

Fig. 16.—Growing Alderman variety in the Arroyo Grande Valley. First strings are placed about the vines while they are still small.

feet or more (fig. 15). The pods are about 5 inches long, dark green, pointed, and occur singly. They are late maturing, prolific, and bear over a long season. The growing of this variety in San Luis Obispo County has increased from 40 acres in 1930, to 500 in 1933. In this district the variety is planted from March to August and is harvested from June to November. Only the best of the irrigated soils are used. Commercial fertilizer is applied in large amounts. The rows are spaced 5 feet apart and 1,200 seven-foot stakes per acre are used to carry the trellis of wire and twine (fig. 16). The cost of production is high, that of insecticides alone being as much as $70.00 per acre.

Senator.—The variety Senator is the one grown in San Diego County, but is known there locally as *Admiral.* It is a late variety. The vines are about 30 inches long and dark green. The pods are about 3¾ inches long, pointed, curved, medium light green, and occur mainly in pairs.

Morse's Market.—This is one of the new varieties developed in recent years and is one of the most attractive of the large-podded types. The pods are large, dark colored, well filled, and smooth. It is a good spring and fall variety and matures about a week ahead of Stratagem when planted at the same time.

DISEASES

Fusarium Wilt.—Plants affected by wilt *(Fusarium orthoceras pisi),* become stunted, turn yellow, and the leaves curl prior to death. Often the central core of wilted plants shows an orange or brownish stain. Typically the disease occurs in more or less circular spots in the field, which enlarge from year to year. A period of high soil temperature is necessary for the development of this disease. Although it is present in only one locality in California, it may be that the soil temperatures in most pea-growing areas are not sufficiently high for this disease to become destructive.

Control is obtained through the use of wilt-resistant varieties of which a number are available and are being tested in California. It should be pointed out that a wilt caused by another fusarium is present in the state. The wilt-resistant varieties have not been tested on land infested with this second type of wilt.

Root Rots.—The most important losses from disease in the older districts of other states have been caused by root rots *(Fusarium martii pisi, Pythium* sp., and *Aphanomyces euteiches).* Although the most important root rot fungi have been found in this state, they have not caused great damage under normal weather and cultural conditions. The *Aphanomyces* root rot has been the most destructive pea disease in the eastern and central pea-canning states. The fungus has been found in California, but has not done extensive damage. As it is associated with excessively wet soil conditions it will not likely become destructive in this state.

Fusarium root rot occurs generally throughout the pea-growing areas of the state, taking a scattering of plants, but not, as a rule, in an economically important degree. It requires a higher soil temperature than that which usually prevails in the pea districts.

Pythium root rot requires both a high soil temperature and abundant moisture. Such conditions seldom prevail except during the summer in warm districts and with irrigation.

Leaf, Stem, and Pod Spots.—The fungus, *Ascochyta pisi,* is often associated with *Mycosphaerella* blight in wet weather but is less destructive. The leaf, stem, and pod spots caused by *A. pisi* are circular, tan colored, and ¼ inch or less in diameter.

Under moderately cool and high-humidity conditions another fungus, *Cladosporium,*[3] does some damage by marring the pods. The injury to

[3] From an unpublished manuscript by W. C. Snyder, Division of Plant Pathology, University of California.

the pod appears as dark-brown or black scabs. These may occur as numerous specks or large rough blemishes. The fungus also causes spots on growing leaves and stems.

Leaf-blotch caused by *Septoria pisi* has been of minor importance. The injury is largely confined to the leaf, on which indefinite bleached spots are produced.

Mycosphaerella Blight.—The blight caused by *Mycosphaerella pinodes,* is prevalent in the state and may become destructive in wet weather. The fungus causes purplish-black blotches on the stems, especially near the nodes, and blackens the underground stems. The leaf spots are dark colored. Young seedlings may be killed and older plants turn yellow and cease growth, when the underground stems are severely affected.

Although *Mycosphaerella* blight is seed-borne, severe outbreaks occur almost entirely on land where peas have been grown repeatedly. Crop rotation and destruction of old blighted vines are the most effective measures of control.

Downy Mildew.—The disease known as downy mildew and caused by *Peronsopora viciae,* occurs in both the spring and fall crops and may be responsible for more damage than is apparent. It sometimes becomes very abundant in the spring following cool wet weather and in the fall in fields subject to heavy coastal fogs.

Affected leaves curl downward and a violet-colored velvety fuzz covers the under surface. Affected leaves show a yellowing as seen from the upper surface. Downy mildew sometimes appears as angular leaf spots.

What appears to be this same fungus occasionally causes a pod disease. Affected pods show but little external evidence of the disease except an occasional yellowish blotch when the fungus has developed extensively. Upon opening a diseased pod there is seen a white or tan-colored mealy substance which may involve the entire surface of the pod cavity. Occurrences of this pod trouble have not been associated with epidemics of downy mildew on the leaves. It has been found in combination with pod proliferation as described below.

Powdery Mildew.—This fungus disease, known as powdery mildew *(Erysiphe polygoni),* is present wherever peas are grown; it is especially prevalent late in the season when the weather is warm. It is easily recognized by the powdery, whitish, or grayish coating on all parts of the plant, especially on the upper side of the leaf. It attacks all parts of the plant aboveground and unless checked soon destroys the crop. It causes a yellowing of the leaves, stunting of plants, and often discolors the pods, thus lowering their market value. After the fungus dries on the pod it leaves a sooty spot often ½ inch in diameter.

Powdery mildew can be controlled by dusting with sulfur. The rate of application varies, but seldom exceeds 25 pounds to the acre. The vines should be sulfured before the growth of mildew starts, for the dusting is entirely a preventive measure. Frequent dustings are neces-

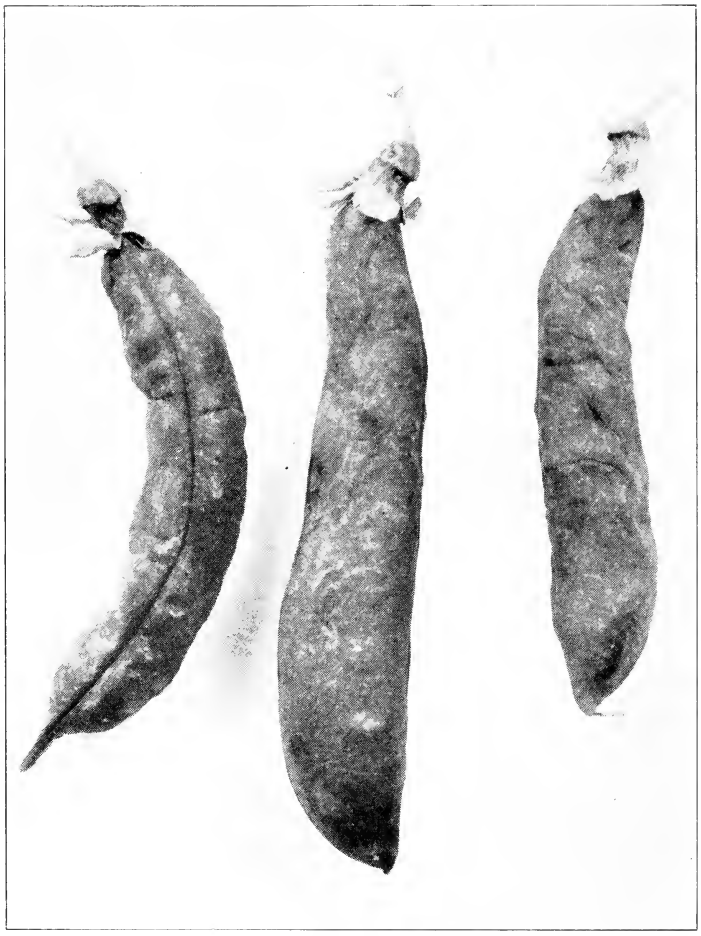

Fig. 17.—Distortion of the pods caused by pea mosaic.

sary, especially while the vines are growing, in order to keep the foliage protected. Hand, traction, and power dusters are used.

The vines should be plowed under as soon as possible after the crop is harvested. In regions where mildew is severe and difficult to control it is best to seed early and plant varieties that mature quickly. Crop rotation should be practiced.

Bacterial Blight.—Bacterial blight *(Pseudomonas pisi)* is one of the most devastating of the pea diseases. Occasionally during cool wet

weather, entire plantings have been destroyed. This disease is found in all parts of the plant aboveground. Extensive watery, olive-green blisters appear on stems and leaf bases, and water-soaked oily spots occur on the pods and leaves. The stem spots may result in girdling, and healthy shoots may arise from below the injured portion of the plant. Cultivation immediately after rains seems to aid the plants in recover-

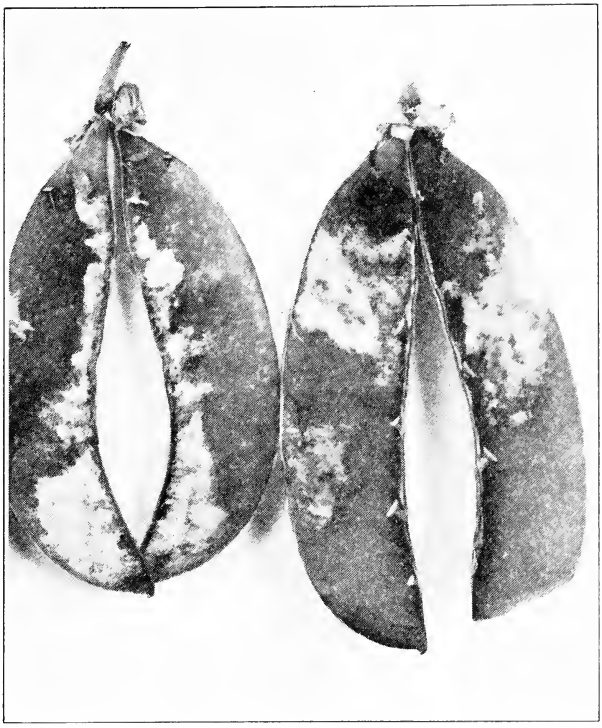

Fig. 18.—Pod proliferation is a cottony-like growth in the interior of the pod.

ing if the infection is not too severe. The bacterium is carried by the seed and is disseminated in the field by rain. The use of clean seed and crop rotation are effective in control.

Mosaic.—This disease is caused by a virus which is transmitted by the pea aphid. The plants may be dwarfed, particularly if infected when small, and the pods are often badly distorted as shown in figure 17. The symptoms range from simple leaf mottling to extreme twisting, curling, and stunting of the foliage. Mosaic has become of considerable concern on summer and fall peas. The loss incurred is through the unmarketability of deformed pods and decrease in yield. Infections occurring prior to the completion of pod formation result in conspicuous pod distortion.

There is no evidence of the disease being carried in the seed. As the chief method of spread is by means of the pea aphid, keeping these insects under control is the best method of preventing spread.

Pod Proliferation.—During certain periods of the coastal pea-growing seasons, patches of white, cottony-like felt, appear on the lining of the pod cavity. This felt, which is a proliferation of the cells of the pod lining, may fill the cavity but does not affect the seed (fig. 18). This abnormal growth apparently arises in response to violent fluctuations in humidity, light, and temperature resulting from intermittent fogs. Other agencies may also induce this condition as it is frequently associated with downy-mildew infections of the pod and has been reproduced by mechanically injuring the pod.

Seed Rot.—Rotting of seed before germination often makes replanting necessary. It may be caused by planting in soil that is too wet or by a heavy rain immediately following planting. Seeds that have had the coats injured in threshing or cleaning are more easily penetrated by rot fungi than those with their coats intact. Treatment of the seed with organic mercury compounds before planting seems to reduce the loss.

INSECT PESTS

Pea Aphid.—By far the most important insect pest of peas is the large green pea aphid, *Illinoia pisi* Kalt., shown in figure 19. It not only damages the plant by sucking out the sap but is also responsible for transmitting mosaic.

Under favorable conditions, in the early spring, the aphids propagate rapidly and at times cause complete crop failures. Alfalfa and other legumes are also hosts to this insect and are a source of infection for the pea crop. In the coastal pea-growing section, it is usually more destructive on the fall than on the spring crop.

Many natural enemies feed on the pea aphid, including the convergent ladybird beetle and the larvae of the syrphid flies. The former, when present in sufficient numbers, helps to keep the pea aphid in check in the spring. It is imported in some sections in the early spring and has been found to give good control. In the fall this task is taken over to a greater degree by the larvae of the syrphid flies. A fungus, *Entomophthora aphidis,* does efficient control work in the early spring under favorable conditions.

The best method of control is to dust the vines at the first appearance of the aphid with a mixture of nicotine sulfate, and some carrier such as hydrated lime, dolomite, sulfur, etc., that gives off the nicotine fumes rapidly. Dry dusts have given better results than liquid sprays. In ap-

plying the dust it is important to get the material into actual contact with the aphid, as the fumes of the nicotine enter the spiracles of the insect and paralyze the nervous system causing its death. Best results are obtained if the dust is applied when the temperature in the shade is above 70° F, when the air is still, and when the plants are dry.

Fig. 19.—The pea aphid is one of the most destructive pests. Aside from directly injuring the plant by sucking out the juice, these insects transmit mosaic.

Some growers prefer to make their own nicotine mixture in order to lower the cost, to have fresher and more effective dust, to control the nicotine sulfate content of the mixture, and to be able to add arsenates, sulfur, or other insecticides or fungicides when desired. Unless care is used home mixing may produce dusts that are too strong or too weak; if factory made they must contain the nicotine content stated on the label of the can.

Usually from 10 to 30 pounds of 8–10 per cent nicotine dust is used per acre for each application, depending on the severity of the attack and the size and density of the vines, and the method of application. If given in time, one application is sufficient but sometimes two or even three applications are necessary to obtain complete control.

Various methods are used to apply the dust—from hand dusting to engine-driven machines capable of dusting 30 to 40 acres per day. The

larger machines drag a strip of canvas 20 to 30 feet long behind the duster to confine the nicotine fumes about the plants.

The Pea Weevil.—The pea weevil (*Mylabris pisorum* Linn.) occurs wherever peas are cultivated. It does very little damage, however, in the colder regions. The adult is about $\frac{3}{16}$ inch long; the ground color is black, but it is covered with a brownish pubescence or variegated with

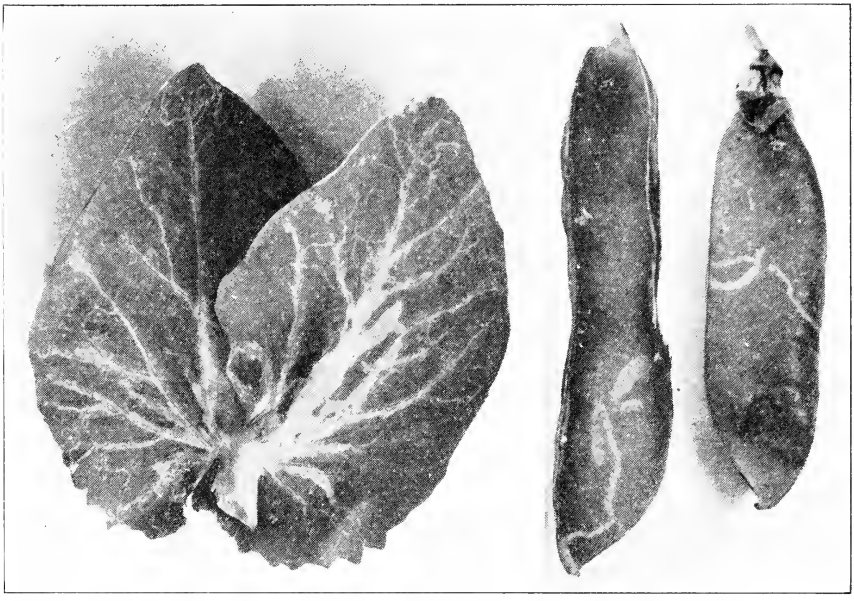

Fig. 20.—Left: Leaf-miner injury on pea leaves. Right: Leaf-miner injury on pods. The larvae burrow channels just beneath the epidermis.

black and white markings. The eggs are deposited singly upon the surface of the pod. Upon hatching, the larva bores through the pod walls and enters the developing seed. It feeds, and then pupates, within the seed. The control most generally used is to fumigate the seed with carbon bisulfide as soon as possible after it has been threshed. Air-tight rooms should be used for fumigation. The liquid is poured into shallow containers and placed above the seed; it soon evaporates and the gas penetrates to all parts of the room. Ten pounds are used for each 1,000 cubic feet of air space. The exposure should be for 48 hours. Best results are obtained at temperatures of 60° F or higher. Owing to the hazard of fire from the use of this material, some of the seed companies are using chlorpicrin (tear gas) at the rate of one pound per 1,000 cubic feet of air space. Chlorpicrin costs about the same as carbon bisulfide, but is much safer from the standpoint of fire and seems to give good control.

Leaf Miner.—The leaf miner (*Liriomyza pictella* Thomson), is responsible for severe damage to the fall pea crop. This small dipterous pest develops in the spring from overwintering puparia. The adult fly,

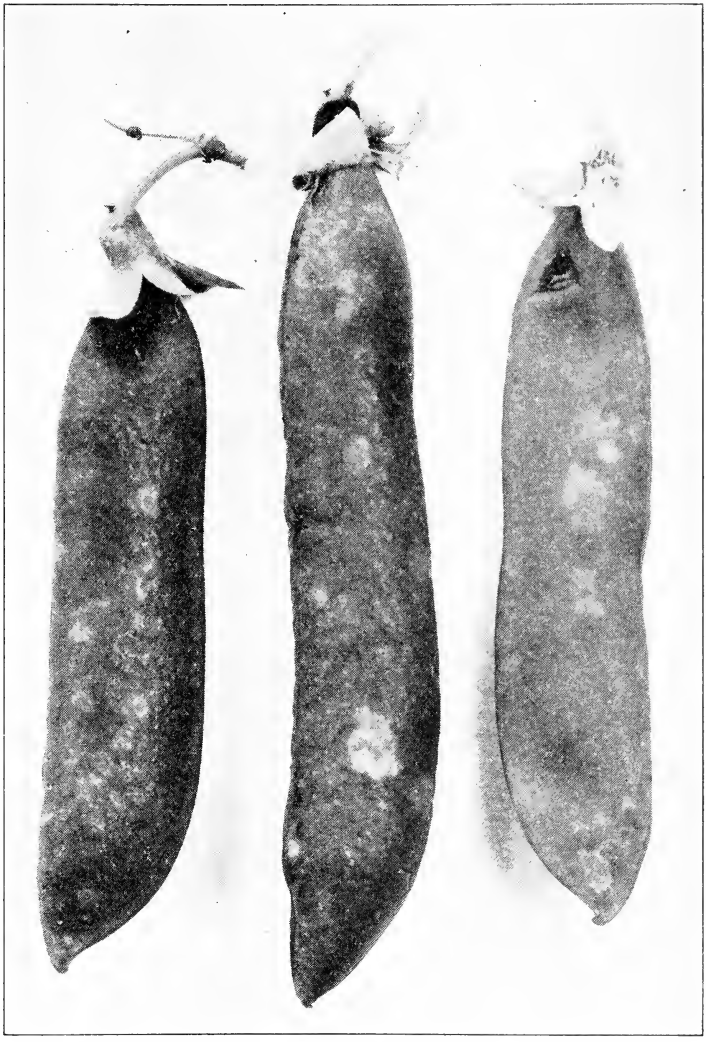

Fig. 21.—Stigmanose is the result of insect stings which cause crater-like, discolored blemishes on the pods.

about 2 millimeters long, deposits eggs under the epidermis of the leaves, stems, and pods of the plant. The eggs hatch into small yellowish maggots which mine just beneath the epidermis producing the characteristic channels of dead tissue shown in figure 20. Severe injury results when the lower portion of the plant is badly mined and when the bur-

rowing in the pods makes them less attractive to the buyer. The early spring crop of peas is usually injured less than those that follow.

Attempts to control this pest have not been entirely satisfactory because all stages of the insect can be found in the field at the same time. Nicotine sulfate sprays at a dilution of 1 to 500 kill the maggots within the mines, but reinfestation takes place from the adults which have not been killed by the spray. A newer development in the control of this insect, is the use of oil and nicotine, with air under pressure as a carrier, instead of water. These are generally referred to as vapor dusts. Their chief advantage is that they kill the adult flies as well as the larvae.

Pod Stigmanose.—In many pea-growing sections a condition of the pods known as stigmanose is produced by the sting of the black grass bug (*Irbisia solani* Heid.) and the tarnished plant bug (*Lygus pratensis* Linn.). The pod, when young and tender, is stung by the bug, leaving a small white puncture. The pod then develops a raised margin of abnormal cells around the sting. The swelling resembles a miniature crater and is a yellowish green in color which contrasts with the darker green of the normal pod (fig. 21), detracting from the appearance materially.

Control measures are extremely difficult. A dust containing 25 to 30 per cent calcium cyanide has been used under some conditions with fair success. Clean cultivation in the pea field and on the lands adjacent is of considerable advantage in keeping these insects in check.

Thrips.—Several species of thrips feed on the blossoms and developing pods of the pea, sometimes causing a blossom drop and distortion of the developing pods which they do not outgrow. The adults hibernate during the winter in rubbish and grass fields; the destruction of these hibernating places is an important factor in their control. The nicotine dusts used for the pea aphid will aid in the control of thrips. A 25 per cent calcium cyanide dust is also reported to be effective in some districts.

Seed Corn Maggot.—The seed-corn maggot (*Hylemyia cilicrura* Rondian), a small white grub about 5 millimeters long, attacks the planted seed and developing seedlings, sometimes causing a poor stand in the early spring plantings. Replanting will usually produce a satisfactory stand. The adult is a small, gray fly.

Red Spider.—Several species of red spider do some damage to peas. Usually the warmer sections of the interior are more severely affected than the coastal regions. Sulfur gives good control, if dusting is done before the red spiders become too numerous.

False Chinch Bugs.—The false chinch bug (*Nysius ericea* Schilling), appears periodically in the late spring crop and may cause considerable damage when present in sufficient numbers. During May and early June,

and especially on warm days, the nymphs swarm over the entire plant sometimes causing it to wilt. In cool weather they are relatively inactive, clustering at the base of the plant. When they reach the adult stage they disperse, after which time the damage is slight. Burning grass lands adjoining the field, and heavy irrigating when the insects are in the nymphal form, will help keep them under control.

ACKNOWLEDGMENTS

The authors wish to express their appreciation for the assistance given in the preparation of this circular to H. A. Jones, H. A. Hunt, E. L. Garthwaite, Wallace Sullivan, and C. Emlen Scott.

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